AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.4.2.5

Titrations (chemistry only)

Past-paper questions

Tier	**Higher**
Question groups	**21**
Available paper years	**2008–2025**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.4.2.5 Titrations (chemistry only)

Question 01

January 2008 | CHY3H | Original Q5 | Legacy

5 In 1916, during the First World War, a German U-boat sank a Swedish ship which was carrying a cargo of champagne. The wreck was discovered in 1997 and the champagne was brought to the surface and analysed.

(a) 25.0 cm^3 of the champagne were placed in a conical flask.

Describe how the volume of sodium hydroxide solution needed to react completely with the weak acids in 25.0 cm^3 of this champagne can be found by titration, using phenolphthalein indicator.

Name any other apparatus used.

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(4 marks)

(b) The acid in 25.0 cm^3 of the champagne reacted completely with 13.5 cm^3 of sodium hydroxide of concentration 0.10 moles per cubic decimetre.

Calculate the concentration in moles per cubic decimetre of acid in the champagne.

Assume that 1 mole of sodium hydroxide reacts completely with 1 mole of acid.

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Concentration = ... moles per cubic decimetre

(2 marks)

4.4.2.5 Titrations (chemistry only)

Question 01 · continued

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(c) Is analysis by titration enough to decide whether this champagne is safe to drink?

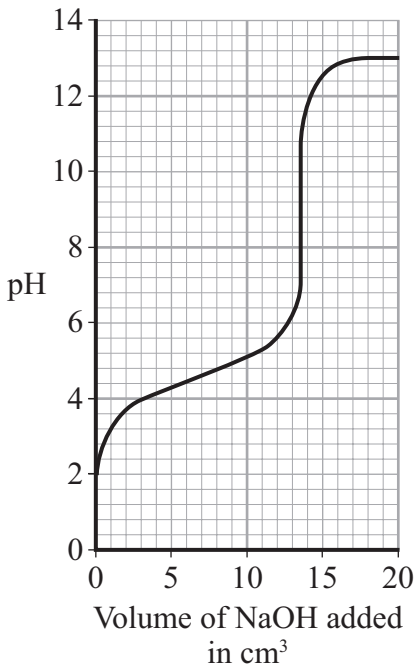
Explain your answer.

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(1 mark)

(d) The graph shows how the pH of the solution changes during this titration.



Phenolphthalein is the indicator used in this titration. It changes colour between pH 8.2 and pH 10.0.

Methyl orange is another indicator. It changes colour between pH 3.2 and pH 4.4.

Suggest why methyl orange is **not** a suitable indicator for this titration.

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(2 marks)

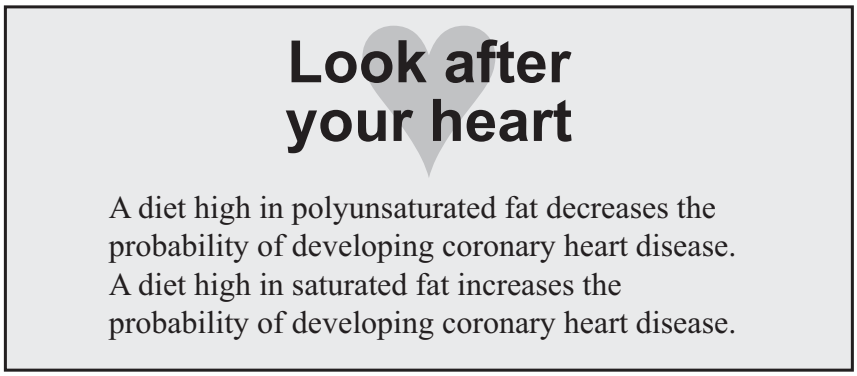
9

4.4.2.5 Titrations (chemistry only)

Question 02

June 2008 | CHY1H | Original Q5 | Legacy

5



5 (a)

Type of oil	Polyunsaturated fat in grams per 100 g of oil	Saturated fat in grams per 100 g of oil
Maize	49	16
Olive	11	14
Palm	8	45
Soya Bean	57	14

Use the information from the table above to answer each question.

5 (a) (i) Which type of oil appears to be best for your heart? Explain your answer.

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(2 marks)

5 (a) (ii) Cultures that use only olive oil in food preparation have less heart disease than cultures that use other types of oil.

Suggest a possible reason for this.

.....

.....

(1 mark)

4.4.2.5 Titrations (chemistry only)

Question 02 · continued

for mark

5 (b) A company compared the relative 'unsaturation' of five oils. Bromine water was added from a burette to equal amounts of each oil until the bromine water remained orange-yellow.

The volume added was recorded.

Type of oil	Volume of bromine water added in cm^3
Maize	25.6
Olive	6.1
Palm	4.9
Soya Bean	29.9
Sunflower	25.1

5 (b) (i) What would you see when the first few drops of bromine water are added to each oil?

.....

(1 mark)

5 (b) (ii) What do these results tell you about sunflower oil compared with the other oils?

.....

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.....

.....

(2 marks)

6

4.4.2.5 Titrations (chemistry only)

Question 03

7 Aminoethanoic acid (glycine), NH_2CH_2COOH, is an amino acid. It is found in fish, meat, beans and dairy produce. It can behave both as an acid and as a base.

7 (a) Explain, in terms of Brønsted and Lowry's ideas, why aminoethanoic acid behaves as:

an acid when it reacts with sodium hydroxide

$$NH_2CH_2COOH + Na^+OH^- \rightarrow NH_2CH_2COO^-Na^+ + H_2O$$

.....

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a base when it reacts with hydrochloric acid.

$$NH_2CH_2COOH + H^+Cl^- \rightarrow NH_3^+CH_2COOH + Cl^-$$

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(3 marks)

4.4.2.5 Titrations (chemistry only)

Question 03 · continued

for mark

7 (b) In a titration, 25.00 cm^3 of a solution of aminoethanoic acid reacted with 18.40 cm^3 of sodium hydroxide solution of concentration 0.15 moles per cubic decimetre.

The equation which represents the reaction is:

$$NH_2CH_2COOH + Na^+OH^- \rightarrow NH_2CH_2COO^-Na^+ + H_2O$$

7 (b) (i) Calculate the concentration of aminoethanoic acid in moles per cubic decimetre.

.....

.....

.....

.....

Concentration = ... moles per cubic decimetre

(2 marks)

7 (b) (ii) Name an indicator used for weak acid-strong alkali titrations.

.....

(1 mark)

6

4.4.2.5 Titrations (chemistry only)

Question 04

6 This label was on a bottle of vinegar.



Vinegar contains ethanoic acid, which is a *weak* acid.

6 (a) (i) According to Arrhenius, acids are chemicals that produce hydrogen ions (H^+) in aqueous solution.

Complete the following equation to show why ethanoic acid (CH_3COOH) is an acid in aqueous solution.

$$CH_3COOH\ (l) \xrightleftharpoons{\text{water}} \text{.....}\ (aq) + \text{.....}\ (aq)$$

(1 mark)

6 (a) (ii) Explain the meaning of *weak* in terms of ionisation.

.....

.....

(1 mark)

6 (a) (iii) What is the Brønsted and Lowry definition of acids?

.....

(1 mark)

6 (b) 25.0 cm^3 of diluted vinegar were placed in a conical flask using a pipette.

The volume of sodium hydroxide solution needed to react completely with the ethanoic acid in 25.0 cm^3 of diluted vinegar can be found by titration using phenolphthalein indicator.

6 (b) (i) Why is phenolphthalein used instead of methyl orange for this titration?

.....

.....

(1 mark)

4.4.2.5 Titrations (chemistry only)

Question 04 · continued January 2011 | CHY3H | Original Q6 | Legacy

6 (b) (ii) Describe how you would do the titration.

You should include the names of any apparatus you would use.

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(4 marks)

6 (c) The ethanoic acid in 25.0 cm^3 of diluted vinegar reacted completely with 15.0 cm^3 of sodium hydroxide solution of concentration 0.10 moles per cubic decimetre.

The equation which represents this reaction is:

$$CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$$

Calculate the concentration of ethanoic acid in moles per cubic decimetre.

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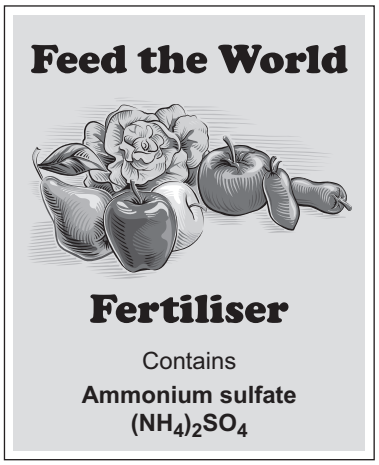
Concentration = ... moles per cubic decimetre
(2 marks)

10

4.4.2.5 Titrations (chemistry only)

Question 05

5 Ammonium sulfate is an artificial fertiliser.



5 (a) (i) When this fertiliser is warmed with sodium hydroxide solution, ammonia gas is given off. Describe and give the result of a test for ammonia gas.

Test .....

.....

Result .....

.....

(2 marks)

5 (a) (ii) Describe and give the result of a chemical test to show that this fertiliser contains sulfate ions (SO_4^{2-}).

Test .....

.....

Result .....

.....

(2 marks)

5 (b) Ammonium sulfate is made by reacting sulfuric acid (a *strong* acid) with ammonia solution (a *weak* alkali).

5 (b) (i) Explain the meaning of *strong* in terms of ionisation.

.....

(1 mark)

4.4.2.5 Titrations (chemistry only)

Question 05 · continued

5 (b) (ii) A student made some ammonium sulfate in a school laboratory.

The student carried out a titration, using a suitable indicator, to find the volumes of sulfuric acid and ammonia solution that should be reacted together.

Name a suitable indicator for strong acid-weak alkali titrations.

.....

(1 mark)

5 (b) (iii) The student found that 25.0 cm^3 of ammonia solution reacted completely with 32.0 cm^3 of sulfuric acid of concentration 0.050 moles per cubic decimetre.

The equation that represents this reaction is:

$$H_2SO_4\,(aq) + 2NH_3\,(aq) \rightarrow (NH_4)_2SO_4\,(aq)$$

Calculate the concentration of this ammonia solution in moles per cubic decimetre.

.....

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.....

Concentration = ... moles per cubic decimetre

(3 marks)

5 (b) (iv) Use your answer to (b)(iii) to calculate the concentration of ammonia in grams per cubic decimetre.

(If you did not answer part (b)(iii), assume that the concentration of the ammonia solution is 0.15 moles per cubic decimetre. This is **not** the correct answer to part (b)(iii).)

Relative formula mass of ammonia (NH_3) = 17.

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Concentration = ... grams per cubic decimetre

(2 marks)

11

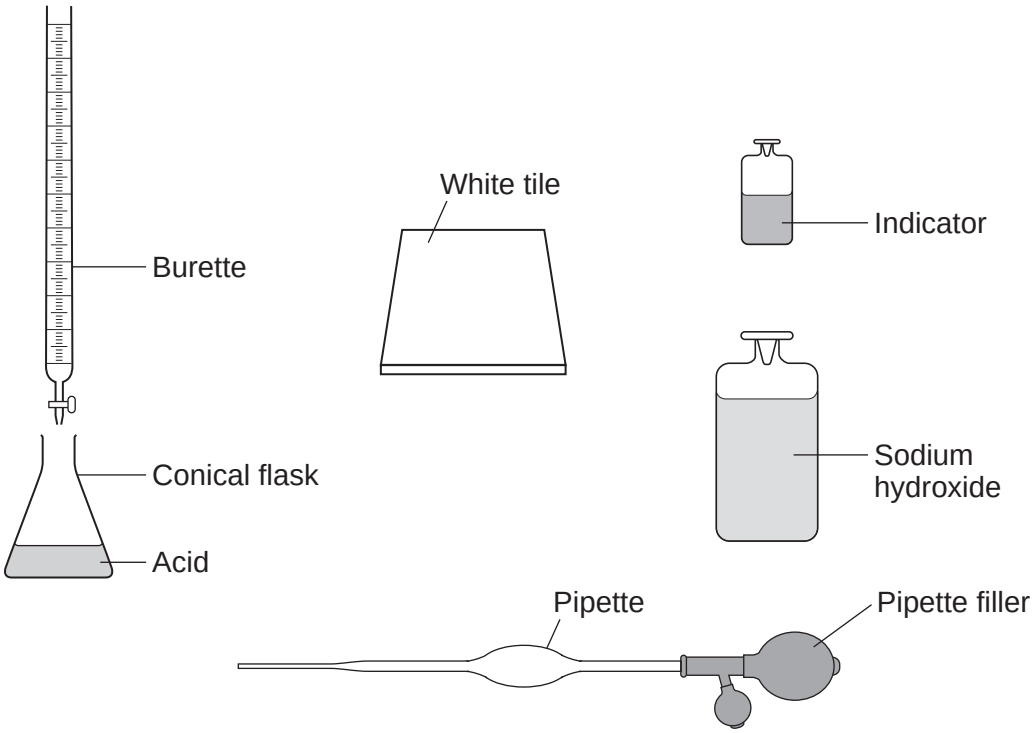
4.4.2.5 Titrations (chemistry only)

Question 06

June 2013 | CH3HP | Original Q3 | Legacy

3 *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

A student used the equipment shown to do a titration.



Describe how a student should use this equipment to find the volume of sodium hydroxide solution that reacts with a known volume of acid.
Include any measurements the student should make.

Do **not** describe how to do any calculations.

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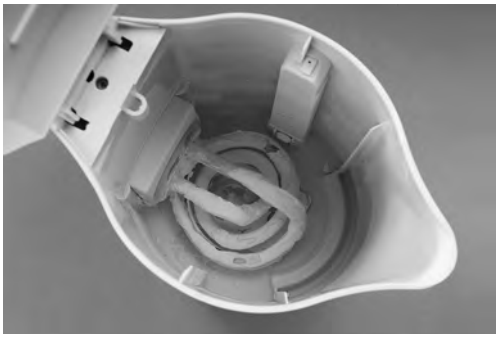
4.4.2.5 Titrations (chemistry only)

Question 07

June 2014 | CH3HP | Original Q4 | Legacy

4 Hard water causes scale in kettles, as shown in **Figure 4**.

Figure 4



4 (a) Acids are used to remove scale.

4 (a) (i) Give the name of a carbonate in scale.

[1 mark]

.....

4 (a) (ii) When acids react with scale a gas is produced.

What is the name of the gas?

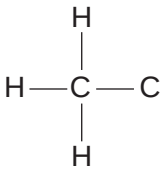
[1 mark]

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4 (b) Ethanoic acid is used to remove scale.

Complete the displayed structure of ethanoic acid (CH_3COOH).

[1 mark]



4.4.2.5 Titrations (chemistry only)

Question 07 · continued

4 (c) A student compared the rates at which ethanoic acid and hydrochloric acid react with scale.

Both acids had the same concentration.

4 (c) (i) The student found that hydrochloric acid reacts faster than ethanoic acid with scale.

Explain why hydrochloric acid reacts faster than ethanoic acid.

[2 marks]

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4 (c) (ii) Hydrochloric acid should **not** be used to dissolve scale in kettles.

Suggest why.

[1 mark]

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4 (d) A student does a titration to find the concentration of a solution of hydrochloric acid.

The student titrates 25.00 cm^3 of hydrochloric acid with sodium hydroxide solution of concentration 0.200 moles per dm^3. The equation for the reaction is:

$$HCl + NaOH \longrightarrow NaCl + H_2O$$

The student added 28.60 cm^3 of sodium hydroxide solution to neutralise the hydrochloric acid.

Calculate the concentration of the hydrochloric acid.

[3 marks]

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Concentration = ... moles per dm^3

9

4.4.2.5 Titrations (chemistry only)

Question 08

7 This question is about chemical analysis.

7 (a) A student has solutions of three compounds, **X**, **Y** and **Z**.

The student uses tests to identify the ions in the three compounds.

The student records the results of the tests in **Table 1**.

Table 1

	Test			
Compound	**Flame test**	**Add sodium hydroxide solution**	**Add hydrochloric acid and barium chloride solution**	**Add nitric acid and silver nitrate solution**
X	no colour	green precipitate	white precipitate	no reaction
Y	yellow flame	no reaction	no reaction	yellow precipitate
Z	no colour	brown precipitate	no reaction	cream precipitate

Identify the **two** ions present in each compound, **X**, **Y** and **Z**.

[3 marks]

X .....

Y .....

Z .....

7 (b) A chemist needs to find the concentration of a solution of barium hydroxide.
Barium hydroxide solution is an alkali.

The chemist could find the concentration of the barium hydroxide solution using two different methods.

Method 1

- An excess of sodium sulfate solution is added to 25 cm^3 of the barium hydroxide solution. A precipitate of barium sulfate is formed.
- The precipitate of barium sulfate is filtered, dried and weighed.
- The concentration of the barium hydroxide solution is calculated from the mass of barium sulfate produced.

4.4.2.5 Titrations (chemistry only)

Question 08 · continued

Method 2

- 25 cm^3 of the barium hydroxide solution is titrated with hydrochloric acid of known concentration.
- The concentration of the barium hydroxide solution is calculated from the result of the titration.

Compare the advantages and disadvantages of the two methods.

[5 marks]

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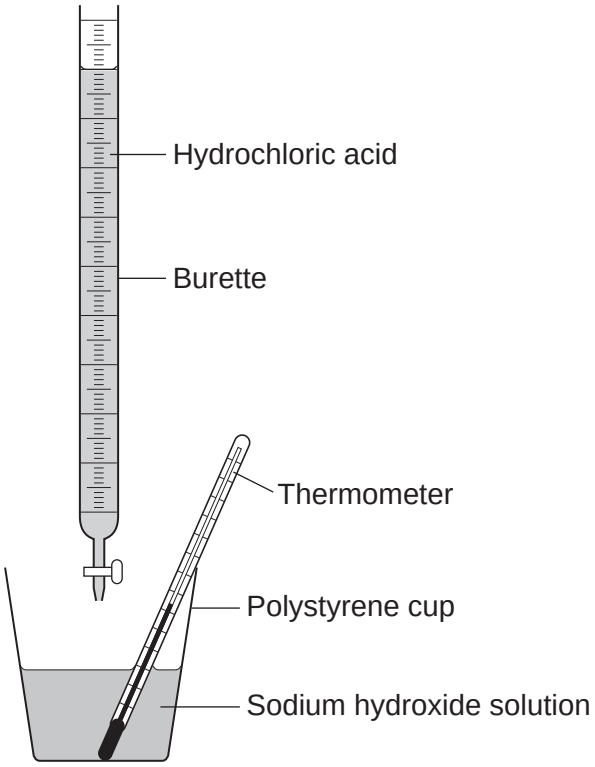
4.4.2.5 Titrations (chemistry only)

Question 09

June 2015 | CH3HP | Original Q8 | Legacy

8 A student investigates the energy released when hydrochloric acid completely neutralises sodium hydroxide solution.
The student uses the apparatus shown in **Figure 4**.

Figure 4



The student:

- measures 25 cm^3 sodium hydroxide solution into a polystyrene cup
- fills a burette with hydrochloric acid
- measures the temperature of the sodium hydroxide solution
- adds 5 cm^3 hydrochloric acid to the sodium hydroxide solution in the polystyrene cup
- stirs the mixture and measures the highest temperature of the mixture
- continues to add 5 cm^3 portions of hydrochloric acid, stirring and measuring the highest temperature of the mixture after each addition.

Question 8 continues on the next page

4.4.2.5 Titrations (chemistry only)

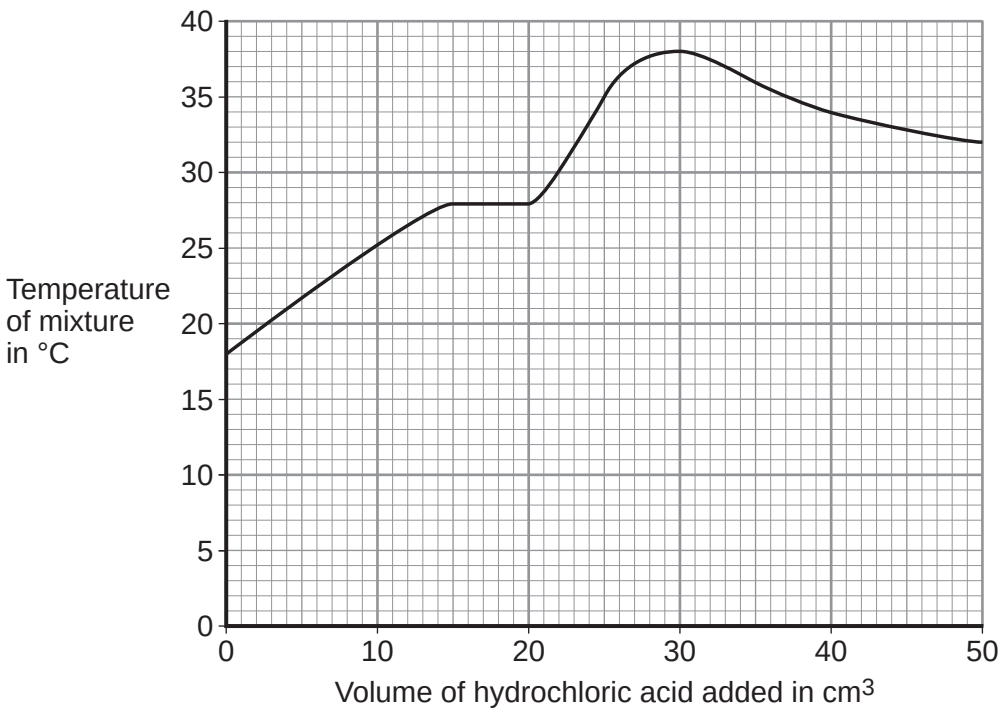
Question 09 · continued

8 (a) The student has plotted a graph of the results.

The graph line has been incorrectly drawn by including an anomalous result.

The graph is shown in **Figure 5**.

Figure 5



8 (a) (i) Suggest a cause for the anomalous result when 20 cm^3 of hydrochloric acid is added.

[1 mark]

.....

.....

8 (a) (ii) Suggest the true value of the temperature of the anomalous point.

[1 mark]

Temperature = ... °C

8 (a) (iii) What was the **total** volume of the mixture when the maximum temperature was reached?

[1 mark]

.....

Total volume of the mixture = ... cm^3

4.4.2.5 Titrations (chemistry only)

Question 09 · continued

8 (a) (iv) Calculate the overall temperature increase in this experiment.

[1 mark]

.....

Overall temperature increase = ... °C

8 (a) (v) Use your answers to **8(a)(iii)** and **8(a)(iv)** and the equation to calculate the energy released in the reaction. Give the unit.

[2 marks]

Assume the volume in cm^3 is equivalent to the mass of solution in grams.

Equation: $Q = mc\Delta T$

where:
Q = energy released
m = mass of solution (g)
c = 4.2 (J per g per °C)
ΔT = change in temperature (°C)

.....

.....

Energy released = ... Unit = ...

8 (b) The student did the experiment on page 19 again, starting with 50 cm^3 of sodium hydroxide solution instead of 25 cm^3.

Explain why this would make no difference to the overall temperature increase.

[2 marks]

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8

4.4.2.5 Titrations (chemistry only)

Question 10

June 2016 | CH3HP | Original Q2 | Legacy

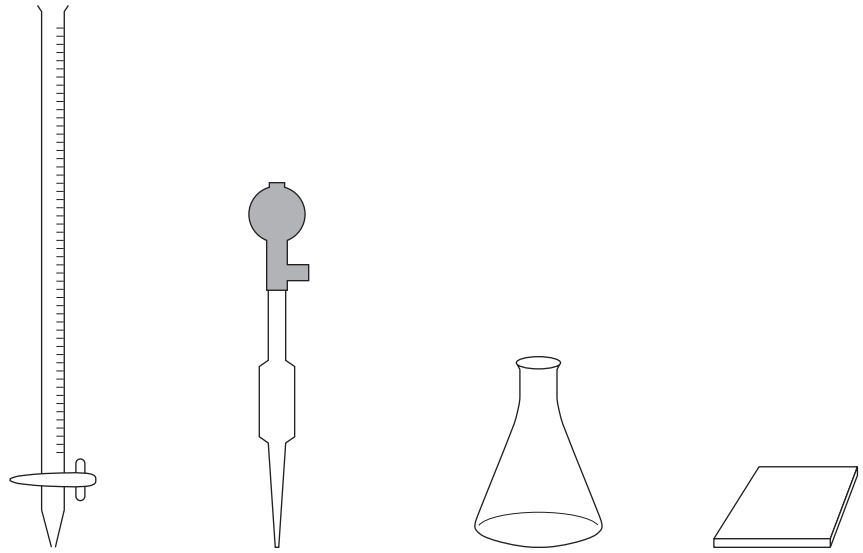
2 **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

A student has to check if two samples of hydrochloric acid, **A** and **B**, are the same concentration.

Describe how the student could use the apparatus and the solutions in **Figure 3** to carry out titrations.

[6 marks]

Figure 3



4.4.2.5 Titrations (chemistry only)

Question 11

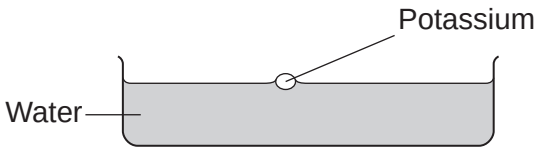
June 2017 | CH3HP | Original Q4 | Legacy

4 This question is about potassium and its compounds.

4 (a) (i) Potassium reacts with water to produce potassium hydroxide solution and a gas.

Figure 8 shows the apparatus used for the reaction.

Figure 8



Complete and balance the equation for the reaction.

[2 marks]

____ K + ____ H_2O ⟶ ____ KOH + _____

4 (a) (ii) Potassium and lithium are in Group 1 of the periodic table.

Give **two** differences you would see between the reactions of potassium and lithium with water.

[2 marks]

_____

_____

_____

_____

4.4.2.5 Titrations (chemistry only)

Question 11 · continued

4 (b) Describe how a student could do titrations to find the mean volume of potassium hydroxide solution which would neutralise 25.00 cm^3 of nitric acid.

[5 marks]

4 (c) The student found that 26.25 cm^3 of potassium hydroxide solution with a concentration of 0.20 moles per dm^3 neutralises 25.00 cm^3 of nitric acid.

The equation for the reaction is:

$$KOH + HNO_3 \longrightarrow KNO_3 + H_2O$$

Calculate the concentration of the nitric acid.

[3 marks]

Concentration of nitric acid = _____ moles per dm^3

12

4.4.2.5 Titrations (chemistry only)

Question 12

June 2018 | 8462/1H | Original Q9

0 9 This question is about acids and alkalis.

0 9 . 1 Dilute hydrochloric acid is a strong acid.

Explain why an acid can be described as both strong and dilute.

[2 marks]

0 9 . 2 A 1.0×10^{-3} mol/dm^3 solution of hydrochloric acid has a pH of 3.0

What is the pH of a 1.0×10^{-5} mol/dm^3 solution of hydrochloric acid?

[1 mark]

pH = _____

Question 9 continues on the next page

4.4.2.5 Titrations (chemistry only)

Question 12 · continued

A student titrated 25.0 cm^3 portions of dilute sulfuric acid with a 0.105 mol/dm^3 sodium hydroxide solution.

0 9 . 3 **Table 4** shows the student's results.

Table 4

	Titration 1	Titration 2	Titration 3	Titration 4	Titration 5
Volume of sodium hydroxide solution in cm^3	23.50	21.10	22.10	22.15	22.15

The equation for the reaction is:

$$2\ NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2\ H_2O$$

Calculate the concentration of the sulfuric acid in mol/dm^3

Use only the student's concordant results.

Concordant results are those within 0.10 cm^3 of each other.

[5 marks]

Concentration of sulfuric acid = _____ mol/dm^3

4.4.2.5 Titrations (chemistry only)

Question 12 · continued

0 9 . 4 Explain why the student should use a pipette to measure the dilute sulfuric acid and a burette to measure the sodium hydroxide solution.

[2 marks]

0 9 . 5 Calculate the mass of sodium hydroxide in 30.0 cm^3 of a 0.105 mol/dm^3 solution.

Relative formula mass (M_r): NaOH = 40

[2 marks]

Mass of sodium hydroxide = _____ g

12

4.4.2.5 Titrations (chemistry only)

Question 13

June 2019 | 8462/1H | Original Q2

0 2 This question is about acids and alkalis.

0 2 . 1 Which ion do all acids produce in aqueous solution?

[1 mark]

Tick (✓) **one** box.

H^+ ☐

H^- ☐

O^{2-} ☐

OH^- ☐

0 2 . 2 Calcium hydroxide solution reacts with an acid to form calcium chloride.

Complete the word equation for the reaction.

[2 marks]

calcium hydroxide + _____ acid → calcium chloride + _____

Question 2 continues on the next page

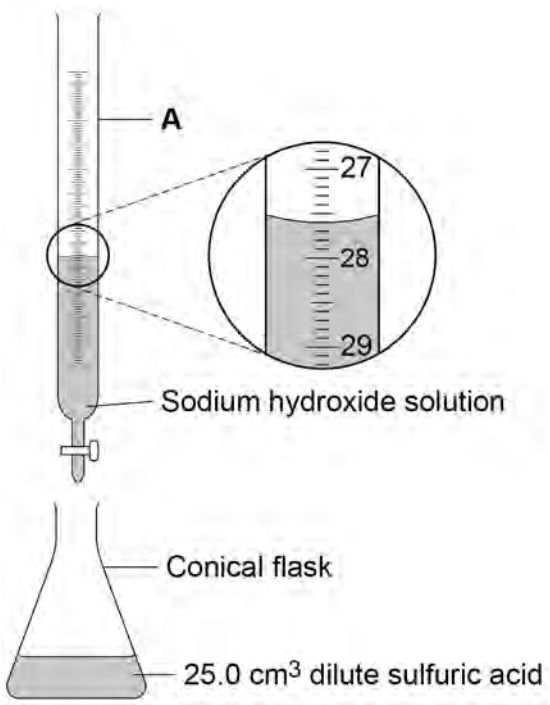
4.4.2.5 Titrations (chemistry only)

Question 13 · continued

A student investigates the volume of sodium hydroxide solution that reacts with 25.0 cm^3 of dilute sulfuric acid.

Figure 2 shows the apparatus the student uses.

Figure 2



Use **Figure 2** to answer Questions **02.3** and **02.4**

0 2 . 3 Name apparatus **A**.

[1 mark]

0 2 . 4 What is the reading on apparatus **A**?

[1 mark]

_____ cm^3

4.4.2.5 Titrations (chemistry only)

Question 13 · continued

0 2 . 5 The higher the concentration of a sample of dilute sulfuric acid, the greater the volume of sodium hydroxide needed to neutralise the acid.

The student tested two samples of dilute sulfuric acid, **P** and **Q**.

Describe how the student could use titrations to find which sample, **P** or **Q**, is more concentrated.

[6 marks]

11

4.4.2.5 Titrations (chemistry only)

Question 14

November 2020 | 8462/1H | Original Q9

0 9 This question is about citric acid ($C_6H_8O_7$).

Citric acid is a solid.

A student investigated the temperature change during the reaction between citric acid and sodium hydrogencarbonate solution.

This is the method used.

1. Pour 25 cm^3 of sodium hydrogencarbonate solution into a polystyrene cup.

2. Measure the temperature of the sodium hydrogencarbonate solution.

3. Add 0.20 g of citric acid to the polystyrene cup.

4. Stir the solution.

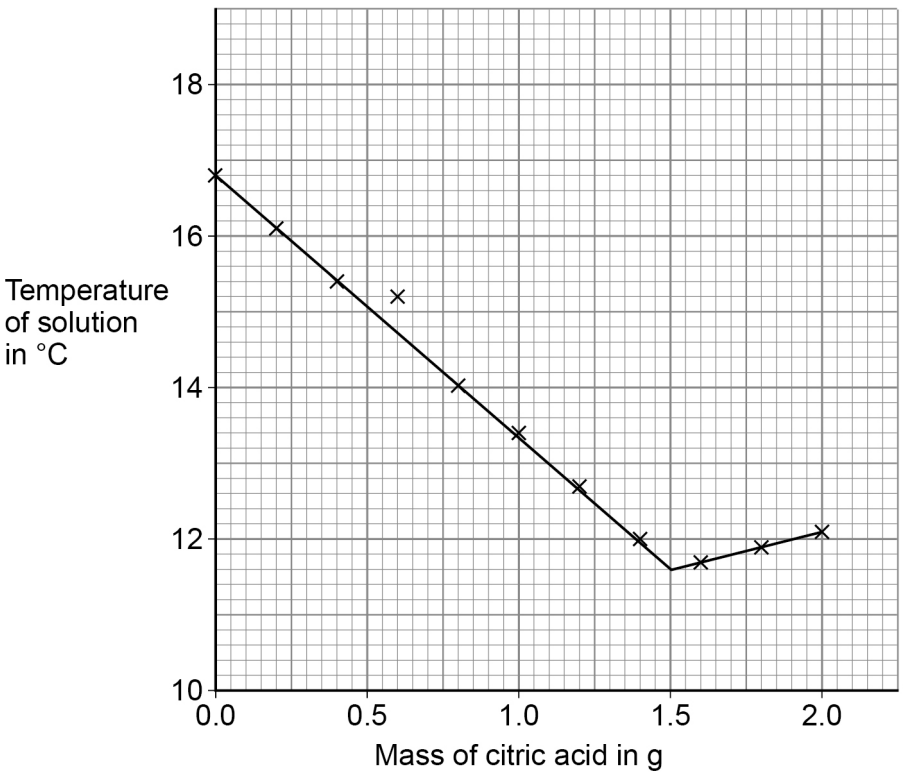
5. Measure the temperature of the solution.

6. Repeat steps 3 to 5 until a total of 2.00 g of citric acid has been added.

The student plotted the results on a graph.

Figure 6 shows the student's graph.

Figure 6



4.4.2.5 Titrations (chemistry only)

Question 14 · continued

0 9 . 1 **Figure 6** shows an anomalous point when 0.60 g of citric acid was added. This was caused by the student making an error.

The student correctly:

- measured the mass of the citric acid
- read the thermometer
- plotted the point.

Suggest **one** reason for the anomalous point.

[1 mark]

0 9 . 2 Explain the shape of the graph in terms of the energy transfers taking place.

You should use data from **Figure 6** in your answer.

[3 marks]

0 9 . 3 A second student repeated the investigation using a metal container instead of the polystyrene cup. The container and the cup were the same size and shape.

Sketch a line on **Figure 6** to show the second student's results until 1.00 g of citric acid had been added. The starting temperature of the solution was the same.

Explain your answer.

[3 marks]

Question 14 · continued

The student used a solution of citric acid to determine the concentration of a solution of sodium hydroxide by titration.

0 9 . 4 The student made 250 cm^3 of a solution of citric acid of concentration 0.0500 mol/dm^3

Calculate the mass of citric acid ($C_6H_8O_7$) required.

Relative atomic masses (A_r): H = 1 C = 12 O = 16

[3 marks]

Mass = _____ g

This is part of the method the student used for the titration.

1. Measure 25.0 cm^3 of the sodium hydroxide solution into a conical flask using a pipette.
2. Add a few drops of indicator to the flask.
3. Fill a burette with citric acid solution.

0 9 . 5 Describe how the student would complete the titration.

[3 marks]

4.4.2.5 Titrations (chemistry only)

Question 14 · continued

0 9 . 6 Give **two** reasons why a burette is used for the citric acid solution.

[2 marks]

1 _____

_____

2 _____

_____

0 9 . 7 13.3 cm^3 of 0.0500 mol/dm^3 citric acid solution was needed to neutralise 25.0 cm^3 of sodium hydroxide solution.

The equation for the reaction is:

$$3\,NaOH + C_6H_8O_7 \rightarrow C_6H_5O_7Na_3 + 3\,H_2O$$

Calculate the concentration of the sodium hydroxide solution in mol/dm^3

[3 marks]

_____

_____

_____

_____

_____

_____

Concentration = _____ mol/dm^3

18

4.4.2.5 Titrations (chemistry only)

Question 15

November 2021 | 8462/1H | Original Q9

0 9 This question is about acids.

Hydrogen chloride and ethanoic acid both dissolve in water.

All hydrogen chloride molecules ionise in water.

Approximately 1% of ethanoic acid molecules ionise in water.

0 9 . 1 A solution is made by dissolving 1 g of hydrogen chloride in 1 dm^3 of water.

Which is the correct description of this solution?

[1 mark]

Tick (✓) **one** box.

A concentrated solution of a strong acid ☐

A concentrated solution of a weak acid ☐

A dilute solution of a strong acid ☐

A dilute solution of a weak acid ☐

0 9 . 2 Which solution would have the lowest pH?

[1 mark]

Tick (✓) **one** box.

0.1 mol/dm^3 ethanoic acid solution ☐

0.1 mol/dm^3 hydrogen chloride solution ☐

1.0 mol/dm^3 ethanoic acid solution ☐

1.0 mol/dm^3 hydrogen chloride solution ☐

4.4.2.5 Titrations (chemistry only)

Question 15 · continued

A student investigated the concentration of a solution of sodium hydroxide by titration with a 0.0480 mol/dm^3 ethanedioic acid solution.

This is the method used.

1. Measure 25.0 cm^3 of the sodium hydroxide solution into a conical flask using a 25.0 cm^3 pipette.
2. Add two drops of indicator to the sodium hydroxide solution.
3. Fill a burette with the 0.0480 mol/dm^3 ethanedioic acid solution to the 0.00 cm^3 mark.
4. Add the ethanedioic acid solution to the sodium hydroxide solution until the indicator changes colour.
5. Read the burette to find the volume of the ethanedioic acid solution used.

0 9 . 3 Suggest **two** improvements to the method that would increase the accuracy of the result.

[2 marks]

1 _____

_____

2 _____

_____

Question 9 continues on the next page

4.4.2.5 Titrations (chemistry only)

Question 15 · continued

0 9 . 4 Ethanedioic acid is a solid at room temperature.

Calculate the mass of ethanedioic acid ($H_2C_2O_4$) needed to make 250 cm^3 of a solution with concentration 0.0480 mol/dm^3

Relative formula mass (M_r): $H_2C_2O_4 = 90$

[2 marks]

Mass = _____ g

0 9 . 5 The student found that 25.0 cm^3 of the sodium hydroxide solution was neutralised by 15.00 cm^3 of the 0.0480 mol/dm^3 ethanedioic acid solution.

The equation for the reaction is:

$$H_2C_2O_4 + 2\,NaOH \rightarrow Na_2C_2O_4 + 2\,H_2O$$

Calculate the concentration of the sodium hydroxide solution in mol/dm^3

[3 marks]

Concentration = _____ mol/dm^3

9

4.4.2.5 Titrations (chemistry only)

Question 16

June 2022 | 8462/1H | Original Q8

0 8 This question is about acids and alkalis.

0 8 . 1 Explain why the pH of an acid depends on:

- the strength of the acid
- the concentration of the acid.

[4 marks]

0 8 . 2 A student titrated 25.00 cm^3 of hydrochloric acid with 0.100 mol/dm^3 barium hydroxide solution.

Table 2 shows the results.

Table 2

Titration number	1	2	3	4	5
Volume of barium hydroxide solution used in cm^3	23.90	23.45	23.55	23.55	23.45

The student calculated the volume of barium hydroxide solution to be used in the titration calculation as 23.50 cm^3.

Explain why the student used a volume of 23.50 cm^3 of barium hydroxide solution in the titration calculation.

[2 marks]

4.4.2.5 Titrations (chemistry only)

Question 16 · continued

0 8 . 3 25.00 cm^3 of the hydrochloric acid reacted with 23.50 cm^3 of the 0.100 mol/dm^3 barium hydroxide solution.

The equation for the reaction is:

$$2\,HCl(aq) + Ba(OH)_2(aq) \rightarrow BaCl_2(aq) + 2\,H_2O(l)$$

Calculate the concentration of the hydrochloric acid in mol/dm^3.

[4 marks]

Concentration of the hydrochloric acid = _____ mol/dm^3

Question 8 continues on the next page

Question 16 · continued

Another student titrated sulfuric acid with barium hydroxide solution.

The equation for the reaction is:

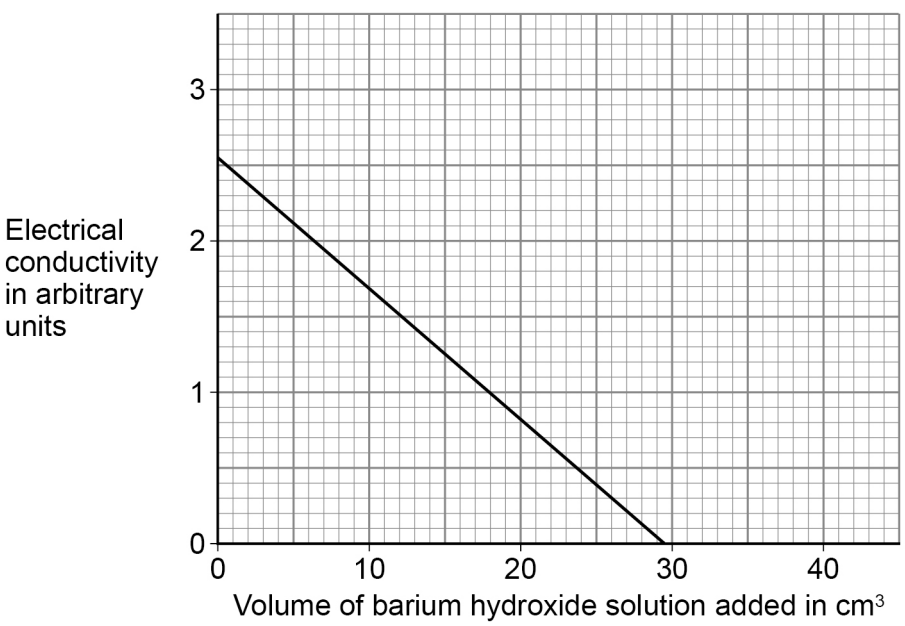
$$H_2SO_4(aq) + Ba(OH)_2(aq) \rightarrow BaSO_4(s) + 2H_2O(l)$$

The student measured the electrical conductivity of the mixture during the titration.

The better a conductor, the higher the electrical conductivity value.

Figure 10 shows the results.

Figure 10



0 8 . 4 Explain why the electrical conductivity of the mixture was zero when the sulfuric acid had just been neutralised.

Use the equation for the reaction.

Refer to ions in your answer.

[3 marks]

4.4.2.5 Titrations (chemistry only)

Question 16 · continued

0 8 . 5 The student then added a further 10 cm^3 of barium hydroxide solution.

The electrical conductivity of the mixture increased.

Give **one** reason why.

[1 mark]

_____

_____

14

4.4.2.5 Titrations (chemistry only)

Question 17

June 2023 | 8462/1H | Original Q5

0 5 This question is about acids and alkalis.

0 5 . 1 Ethanoic acid is a weak acid.

What is meant by 'weak acid'?

Answer in terms of ionisation.

[1 mark]

_____

_____

0 5 . 2 The concentration of an acid can be measured in mol/dm^3.

Which combination of changes **increases** the concentration of an acid?

[1 mark]

Tick (✓) **one** box.

The mass of acid dissolved is halved and the volume of the solution is halved.	☐
The mass of acid dissolved is halved and the volume of the solution is doubled.	☐
The mass of acid dissolved is doubled and the volume of the solution is halved.	☐
The mass of acid dissolved is doubled and the volume of the solution is doubled.	☐

0 5 . 3 The concentration of an acid can be determined by titration.

An indicator is added to an alkali in a flask.

Name an indicator that can be used in this titration.

Give the colour change of the indicator when acid from a burette is added to the alkali in the flask.

[2 marks]

Name of indicator _____

Colour change from _____ to _____

4.4.2.5 Titrations (chemistry only)

Question 17 · continued

0 5 . 4 Sodium carbonate dissolves in water to produce an alkaline solution.

Give the formula of the ion that makes a solution alkaline.

[1 mark]

_____

0 5 . 5 A student does a titration using sodium carbonate solution and nitric acid.

The equation for the reaction is:

$$Na_2CO_3 + 2\,HNO_3 \rightarrow 2\,NaNO_3 + CO_2 + H_2O$$

25.0 cm^3 of 0.124 mol/dm^3 sodium carbonate solution is neutralised by 23.6 cm^3 of nitric acid.

Calculate the concentration of the nitric acid.

Give your answer to 3 significant figures.

You should calculate:

- the number of moles of sodium carbonate in 25.0 cm^3 of the solution
- the number of moles of nitric acid in 23.6 cm^3 of the nitric acid
- the concentration of the nitric acid in mol/dm^3.

[5 marks]

Concentration (3 significant figures) = _____ mol/dm^3

4.4.2.5 Titrations (chemistry only)

Question 17 · continued

When hydrochloric acid dissolves in water, hydrogen ions (H^+) and chloride ions (Cl^-) are produced.

0 5 . 6 A solution of hydrochloric acid with pH 4.5 has a concentration of H^+ ions of 3.16×10^{-5} mol/dm^3.

What is the concentration of H^+ ions in a solution of hydrochloric acid with pH 2.5?

[1 mark]

Concentration of H^+ ions = _____ mol/dm^3

0 5 . 7 Which element has atoms that have the same electronic structure as the chloride ion?

Use the periodic table.

[1 mark]

_____

12

4.4.2.5 Titrations (chemistry only)

Question 18

June 2023 | 8462/2H | Original Q3

0 3 This question is about chemical analysis.

Potassium bromide is used in medicine.

A scientist tested a sample of medicine to show the presence of potassium ions and of bromide ions.

The sample is soluble in water.

0 3 . 1 Plan a method the scientist could use to show that the sample of medicine contains potassium ions **and** bromide ions.

The scientist has:

- a Bunsen burner
- a metal wire
- test tubes
- a dropping pipette
- distilled water
- dilute nitric acid
- silver nitrate solution.

You should give the results of the tests.

[6 marks]

4.4.2.5 Titrations (chemistry only)

Question 18 · continued

The scientist could also use an instrumental method to show the presence of potassium ions in the medicine.

0 3 . 2 Which instrumental method could be used to show the presence of potassium ions in the medicine?

[1 mark]

0 3 . 3 Give **one** advantage of using this instrumental method instead of a chemical test.

[1 mark]

8

4.4.2.5 Titrations (chemistry only)

Question 19

June 2024 | 8462/1H | Original Q9

0 9 This question is about acids and their reactions.

Acids can be either weak or strong.

0 9 . 1 What is meant by 'a **weak** acid'?

[2 marks]

0 9 . 2 Explain what happens to the pH of an acid as the acid is diluted with water.

[2 marks]

Question 9 continues on the next page

4.4.2.5 Titrations (chemistry only)

Question 19 · continued

0 9 . 3 A student does a titration to find the volume of acid needed to neutralise an alkali.

The student fills a burette with the acid.

Give **three** more steps the student must do before adding the acid to the alkali from the burette.

You should name any equipment used.

[3 marks]

1 _____

_____

2 _____

_____

3 _____

_____

0 9 . 4 The student titrated a solution containing 0.0045 moles of sodium hydroxide with 0.15 mol/dm^3 hydrochloric acid.

The equation for the reaction is:

$$NaOH + HCl \rightarrow NaCl + H_2O$$

Calculate the volume of hydrochloric acid in cm^3 needed in the titration.

[2 marks]

_____

_____

_____

Volume of acid = _____ cm^3

4.4.2.5 Titrations (chemistry only)

Question 19 · continued

0 9 . 5 A calcium atom is larger than a magnesium atom.

Explain why calcium reacts more vigorously than magnesium with hydrochloric acid of the same concentration.

[3 marks]

12

4.4.2.5 Titrations (chemistry only)

Question 20

June 2025 | 8462/1H | Original Q8

0 8 This question is about alkalis and acids.

0 8 . 1 What is the formula of the ion that **all** alkalis contain when in solution?

[1 mark]

_____

A student planned a titration experiment to determine the concentration of a sodium hydroxide solution.

This is the student's plan.

1. Measure 25.0 cm^3 of sulfuric acid of known concentration using a pipette.
2. Add the sulfuric acid to a conical flask.
3. Add 3 drops of universal indicator to the conical flask.
4. Place the conical flask on a white tile.
5. Fill a burette with sodium hydroxide solution to the 0.00 cm^3 mark.
6. Add sodium hydroxide solution to the conical flask and swirl the flask.
7. Stop adding sodium hydroxide solution when there is a colour change.
8. Record the volume of sodium hydroxide solution used.
9. Repeat steps 1 to 8 until consistent results are obtained.

0 8 . 2 Suggest **two** improvements to the plan.

Give **one** reason for each improvement.

[4 marks]

Improvement 1 _____

_____

Reason _____

_____

Improvement 2 _____

_____

Reason _____

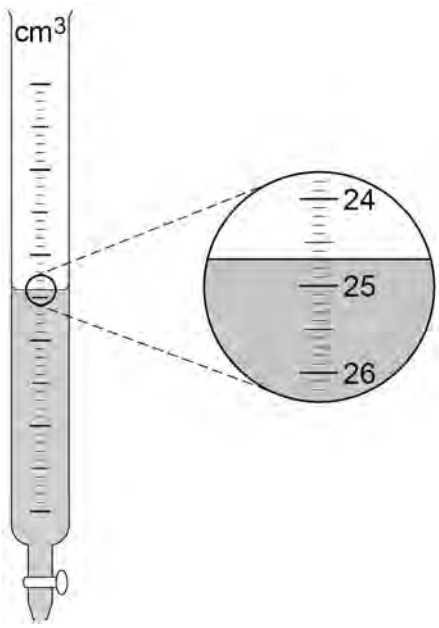
_____

4.4.2.5 Titrations (chemistry only)

Question 20 · continued

0 8 . 3 **Figure 9** shows the burette after one titration.

Figure 9



What is the reading on the burette?

[1 mark]

_____ cm^3

4.4.2.5 Titrations (chemistry only)

Question 20 · continued

0 8 . 4 In a different titration, 25.0 cm^3 of 0.216 mol/dm^3 sulfuric acid needed 11.25 cm^3 of sodium hydroxide solution for neutralisation.

The equation for the reaction is:

$$2\ NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2\ H_2O$$

Calculate the concentration of the sodium hydroxide solution.

[4 marks]

Concentration = _____ mol/dm^3

Question 8 continues on the next page

Question 20 · continued

Table 4 gives information about solutions of two acids.

Table 4

Formula of acid	Concentration of solution in mol/dm^3	Percentage (%) of acid molecules that are ionised
HCl	0.1	100
HCN	2.0	0.01

0 8 . 5 Which is a correct statement about the solutions of HCl and HCN in **Table 4**?

[1 mark]

Tick (✓) **one** box.

The HCl is a more concentrated and stronger acid than the HCN. ☐

The HCl is a more concentrated and weaker acid than the HCN. ☐

The HCl is a more dilute and stronger acid than the HCN. ☐

The HCl is a more dilute and weaker acid than the HCN. ☐

0 8 . 6 In **Table 4**, the solution of HCl has a lower pH than the solution of HCN.

Explain why.

Use the data in **Table 4**.

[2 marks]

13

4.4.2.5 Titrations (chemistry only)

Question 21

0 1 A student investigated the mass of dissolved solids in sea water.

This is the method used.

1. Weigh an empty evaporating basin.
2. Measure 10.0 cm^3 of sea water sample **A** into the evaporating basin using a burette.
3. Heat the evaporating basin until all the water seems to have evaporated.
4. Weigh the evaporating basin and contents.
5. Calculate the mass of dissolved solids in the sample.
6. Repeat steps 1 to 5 with sea water samples **B**, **C** and **D**.

0 1 . 1 Why did the student use a burette rather than a measuring cylinder to measure 10.0 cm^3 of each sample?

[1 mark]

0 1 . 2 What was the dependent variable in this investigation?

[1 mark]

0 1 . 3 Describe how the student could make sure **all** of the water had evaporated in **step 3**.

[2 marks]

0 1 . 4 How did the student calculate the mass of dissolved solids in each sea water sample?

[1 mark]

4.4.2.5 Titrations (chemistry only)

Table 1 shows the results.

Table 1

Sea water sample	A	B	C	D
Mass of dissolved solids in grams	0.35	0.37	0.33	0.34

0 1 . 5 Calculate the mean concentration of dissolved solids in 10.0 cm^3 samples of sea water **A**, **B**, **C** and **D**.

Use **Table 1** and the equation:

$$\text{mean concentration of dissolved solids } (g/dm^3) = \frac{\text{mean mass of dissolved solids (g)}}{\text{volume of sample } (dm^3)}$$

Give your answer in g/dm^3.

[5 marks]

Mean concentration = _____ g/dm^3

0 1 . 6 Suggest why sea water samples **A**, **B**, **C** and **D** contain different masses of dissolved solids.

[1 mark]

11